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Potential Analysis of Chinese Mechanical and Electrical Products Export to France—An Empirical Study Based on the Extended Trade Gravity Model

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Abstract: Under the support and guidance of the Belt and Road initiative, China has welcomed new opportunities for the export of mechanical and electrical products to France. By selecting the SITC Class 7 machinery and transport equipment as the research object, this paper firstly analyzes the current situation of Chinese Mechanical and Electrical Products Export to France. Secondly, this paper analyzes and calculates the influence factors and potentials of Chinese mechanical and electrical products export to France from 1998 to 2017 based on the expanded trade gravity model. The results show that: the main influence factors of China's export of mechanical and electrical products to France are GDP of China's mechanical and electrical products, the GDP of China and France, bilateral distance and trade openness, and the GDP of China's mechanical and electrical products is the most important reason. According to the export trade potential calculated by the regression results, the export trade relationship of mechanical and electrical products between China and France belongs to the potential development type, and the trade potential needs to be further explored. Conclusively, in terms of the outcomes of empirical analysis, some specific suggestions are put forward to further improve Chinese mechanical and electrical products export to France. First, modernizing the national governance system and governance capacity. Second, increasing the investment in scientific research and personnel training in the mechanical and electrical industry. Third, increasing investment in infrastructure along the China Europe train. Fourth, digging the potential of "one belt and one road" cooperation. Fifth, promoting independent brands. Sixth, focusing on cross-border e-commerce of mechanical and electrical products.

Keywords: France, mechanical and electrical products, export potential, influence factor, trade gravity model

1. INTRODUCTION

China's cross-border e-commerce has developed rapidly in recent years, and is increasing at a rate of 30% to 40% per year. By 2020, China's cross-border e-commerce import and export scale is expected to reach 12 trillion yuan. As France's response to the Belt and Road initiative has become more and more active, the scale of trade in mechanical and electrical products between China and France has expanded in general. As the fastest-growing and most popular trade mode in the Internet era, cross-border e-commerce has undoubtedly become a new bright spot in the economic and trade exchanges of mechanical and electrical products between China and France. This paper analyzes and calculates the influencing factors and potentials of Chinese mechanical and electrical products export to France from 1998-2017 based on the expanded trade gravity model, which is of great significance to promote the development of economic and trade relations between China and France. At the same time, it can also provide empirical reference for trade with different countries and products.

The trade gravity model is often used in the field of mechanical and electrical products. Using the trade gravity model, Huang Jie, Yin Xiongyan and Jin Li (2015) analyzed China's export trade of mechanical and electrical products to Germany and found that the economic scale of Germany is the most important factor through the trade gravity model^[1]. Hu Mei, Liu Chunsheng and Wang Yunjie (2015) calculated China's trade potential of mechanical and electrical products to the six ASEAN countries through the trade gravity model, and

believed that the establishment of the ASEAN Free Trade Area promoted the expansion of trade scale^[2]. Che Chunli and Xu an (2016) analyzed and calculated the influencing factors and potentials of Chinese mechanical and electrical products export to central and eastern European countries from 1997-2014 based on the expanded trade gravity model^[3]. Huang Weixin and Lu daofen (2017) estimated the trade potential of China's mechanical and electrical products exported to ASEAN countries through the trade gravity model, the result showed that : generally, the export potential to ASEAN markets was promising in the future, but the export potential of different kinds of China's mechanical and electrical products varied in different ASEAN countries^[4]. According to the trade data of 34 countries along the "one belt and one road" area in the past 2000-2015 years, Zeng Xiaoqiang (2017) built the stochastic frontier gravity model, calculated the export potential of China's mechanical and electrical products, and found that the per ca pita GDP of the importing country and the population of both sides can promote the export trade of China's mechanical and electrical products, while China's per ca pita GDP and bilateral distance play an obstacle role^[5]. At present, few scholars study the trade of mechanical and electrical products between China and France. Under the background of sluggish global trade activities, maintaining the stable growth of the trade of mechanical and electrical products to France is not only conducive to improving the share of China's mechanical and electrical products in the French market, but also conducive to accelerating China's transition from a trading power to a trading power. Therefore, this study has practical significance. At the same time, this paper uses the combination of theoretical analysis and empirical test, and uses the extended trade gravity model to analyze the significance of the factors that affect China's export of mechanical and electrical products to France, and measures the export potential. Therefore, this study has economic significance.

2. THE CURRENT SITUATION OF CHINESE MECHANICAL AND ELECTRICAL PRODUCTS EXPORT TO FRANCE

According to the standard classification of international trade (SITC) formulated by the United Nations Statistical Commission, combined with the characteristics of mechanical and electrical products, this paper selects the 7th category under the SITC Rev. 3 standard to represent the mechanical and electrical products under study. All the data are from the UNCOMTRADE database. The main categories are shown in Table 1.

Table 1. Classification of mechanical and electrical products under SITC Rev. 3 standard

SITC classification	Classification product name
7	Machinery and transportation equipment
71	Power generation machinery and equipment
72	Special industrial machinery
73	Metalworking machinery
74	General industrial machinery and parts
75	Office machinery and automatic data processing equipment
76	Telecommunications and recording and sound equipment and instruments
77	Electric machinery, appliances and electrical parts
78	Land vehicles (including air cushion vehicles)
79	Other transportation equipment

Table 2 shows the export volume of China's mechanical and electrical products to France in 1998-2017 and its proportion in the goods trade between China and France. Although China's exports of mechanical and electrical products to France have experienced negative growth in some years, the overall growth is fluctuating.. The export volume reached the highest point in 2011. China's export of mechanical and electrical products to France needs to inject new vitality and expand the growth space.

Table 2. China's exports of mechanical and electrical products to France in 1998-2017 (US \$100 million)

Year	Exports of mechanical and electrical products	Proportion of export volume of mechanical and electrical products in goods trade (%)
1998	9.58	33.84
1999	10.25	34.98
2000	15.34	41.28
2001	14.36	38.79
2002	16.30	39.88
2003	41.27	56.29
2004	57.46	57.65
2005	59.61	50.99
2006	70.52	50.45
2007	114.66	56.02
2008	120.39	51.23
2009	110.73	51.24
2010	139.50	50.07
2011	139.88	46.25
2012	115.87	42.61
2013	106.49	39.52
2014	114.85	39.64
2015	108.28	40.03
2016	100.07	40.10
2017	118.56	42.40

Source: calculated by UN COMTRADE

It is worth noting that according to the survey report "French industrial manufacturing" issued by the French strategic Bureau under the French Prime Minister's office at the end of 2018, French companies' investment in machinery and equipment is obviously lacking, and the domestic investment in France is showing a significant imbalance, which directly causes the inefficiency of French production sector ^[6]. Therefore, from the perspective of future development trend, China's export of mechanical and electrical products to France still has a large space for cooperation. Therefore, We need to recognize the situation, establish strategic thinking and global vision, use cross-border e-commerce to aggregate the mechanical and electrical industry, and expand the types of mechanical and electrical products with international competitiveness.

3. EMPIRICAL ANALYSIS OF INFLUENCE FACTORS

3.1. Model setting and variable description

3.1.1. Model building

Trade Gravity model is an effective tool to study international trade. The basic expression of trade gravity model is as follows:

$$T_{ij} = A \times Y_i \times \frac{Y_j}{D_{ij}} \quad (1)$$

Its corresponding economic meaning is interpreted as that the trade scale of both sides is positive proportional to their respective economic aggregate and inverse proportional to the distance between them. The trade gravity model is simple and flexible, which enables scholars to add some variables to explain the actual trade phenomenon on the basis of the basic trade gravity model according to the characteristics of the research object. This paper analyzes various factors and its significance of China's export trade of mechanical and electrical products to France. Therefore, the following will combine the actual research content and data availability to introduce relevant variables. Since the space distance between China and France is constant and cannot be directly used for quantitative analysis, but the transportation cost formed by distance is actually constantly changing, Therefore, Based on the method of Jiang Dianchun and Zhang Qingchang (2011), the transportation cost is equal to the product of the bilateral distance between China and France multiplied by the international oil price^[7]. The expanded trade gravity model constructed in this paper is as follows:

$$\ln EXP_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j + \beta_5 \ln TO_i + \beta_6 \ln TO_j + \beta_7 \ln INO_i + \beta_8 \ln DIS_{ij} + \beta_9 REER + B_{10} \ln GDP GDP_{ij} + \varepsilon_{ij} \quad (2)$$

Where, EXP_{ij} is the interpreted variable, which refers to China's exports of mechanical and electrical products to France. β_0 is a constant term, β_k ($k = 1, 2, \dots, 10$) is the regression coefficient of the explanatory variable, and ε_{ij} is the random error term.

3.1.2 Variable description

Before regression analysis of the model, it is necessary to explain the meaning and expected symbols of explanatory variables, as shown in Table 3:

Table 3 Meanings, expected symbols and explanation of explanatory variables in the model

Variable	Meaning	Anticipation symbol	Explain
GDP_i	China's GDP	+	Reflecting China's export capacity, the larger the economic scale is, the greater China's export volume will be.
GDP_j	French GDP	+	Reflecting the import demand of France, the larger the economic scale is, the larger the import volume of France is.
POP_i	China's population	Uncertain	The population reflects the market potential of a country. The more population, the stronger demand. Brada (1985) believed that the export volume was positively correlated with the population of the importing country and negatively correlated with the population of the exporting country ^[8] .
POP_j	Population of France		
TO_i	China's trade openness	+	It reflects the market opening degree of a country. The higher the opening degree is, the higher the level of economic development is, and the overall trade volume will be increased.
TO_j	Trade openness of France		
INO_i	GDP of China's mechanical and electrical products	+	It is expressed in terms of China's industrial added value, reflecting a country's industrial production capacity and development level, as well as the supply capacity of exporting countries.

Variable	Meaning	Anticipation symbol	Explain
DIS_{ij}	Bilateral distance	—	Bilateral distance hinders bilateral trade by affecting trade costs.
$REER$	RMB real effective exchange rate index	+	Excluding the impact of inflation on the change of the value of money itself, it can comprehensively reflect the RMB's external value and relative purchasing power, which can be used to measure the international competitiveness of a country's trade goods. The higher the index, the greater the value of Chinese exports.
$GDPGDP_{ij}$	The gap of per capita income between China and France	—	It is replaced by the per capita GDP gap between the two countries. The closer the per capita GDP gap between the two countries is, the smaller the gap is, the more similar the demand structure is, and the greater the trade volume is.

3.2. Data source

The statistical caliber of mechanical and electrical products is the 7th category of the third edition of international trade standard (SUC Rev. 3). All trade data are from the UN COMTRADE database of the UN statistics agency. China's and France's GDP, per capita GDP and population come from the National Accounts Main Aggregates Database of the United Nations statistics office, in which both GDP and per capita GDP are calculated at the constant price of US dollars in 2010. The trade openness of China and France is calculated according to the formula $TO = (EX - IM)/GDP$. EX represents a country's total export and IM represents a country's total import. The data comes from the UN COMTRADE database. The data of China's industrial added value comes from the National Bureau of statistics. The distance between China and France, that is, the space distance between Beijing and Paris, comes from www.gpspg.com, and the international oil price comes from EIA. The real effective exchange rate index of RMB comes from the website of the bank for International Settlements (BIS).

3.3. Regression results and analysis

3.3.1 Unit root test

In order to avoid the phenomenon of "pseudo regression" caused by non-stationary time series, unit root test is carried out for variables before co integration analysis. In this paper, ADF test is used to determine whether the variables are stable. From the results of unit root test, the ADF test statistical value of the original sequence of all variables is greater than the critical value under the level of 10% significance, that is, the variable fails to pass the stationery test and has unit root. After the first-order difference of each variable, it is still not stable. In the second-order difference, it is found that $Lnpop_i$ and $Lnpop_j$ still fail to pass the stationery test, while the ADF test values of other variables are less than the critical value under the 1% significance level, that is, passing the stationery test. Therefore, in the following analysis, the population of China and France are excluded, and other sequences are second-order single integration, which can be used for co integration test.

3.3.2 Co integration test

Before establishing the regression model, EG two-step method is used to do co integration test and quantitative analysis between variables. The test results are as follows: the residual sequence of the per capita GDP difference between China and France is not stable at the significance level of 10%, therefore, we exclude this variable. The residual sequence of the other seven variables is stable at the significance level of 5%, which shows that the GDP of China and France, the openness of trade between China and France, the GDP of China's mechanical and electrical products, the bilateral distance, and the real effective exchange rate index of RMB have a long-term stable equilibrium relationship with China's exports of mechanical and electrical products to France.

3.3.3 Regression analysis

Through a series of tests mentioned above, after removing relevant variables, the new model is as follows:

$$\text{Ln}T_{ij} = \beta_0 + \beta_1 \text{LnGDP}_i + \beta_2 \text{LnGDP}_j + \beta_3 \text{LnTO}_i + \beta_4 \text{LnTO}_j + \beta_5 \text{LnINO}_i + \beta_6 \text{LnDIS}_{is} + \beta_7 \text{REER} + \varepsilon_{ij} \quad (3)$$

Using Eviews8.0 and ordinary least squares (OLS) for multiple linear regression, the results are shown in Table 4:

Table 4. Regression results of multiple linear models

Variable	Coefficient	Standard error	T Statistics	P value
C	-13.68631	27.8653	-0.49116	0.6315
LnGDP _i	1.08365	0.45939	2.35889	0.0398
LnGDP _j	0.90535	0.35726	2.53418	0.0256
LnTO _i	0.82361	0.32082	2.56722	0.0234
LnTO _j	0.64135	0.30722	2.08756	0.0713
LnINO _i	2.68035	0.48637	5.51099	0.0068
LnDIS _{ij}	-0.38754	0.13003	-2.98038	0.0106
REER	0.01461	0.00543	2.69058	0.0185
R ² =0.99284 Adjusted R ² =0.98954				
F=300.5545 P VALUE=0.000000 D.W. =2.01599				

The estimated equation from OLS is:

$$\text{Ln}T_{ij} = -13.68631 + 1.08365 \text{LnGDP}_i + 0.90535 \text{LnGDP}_j + 0.82361 \text{LnTO}_i + 0.64135 \text{LnTO}_j + 2.68035 \text{LnINO}_i - 0.38754 \text{LnDIS}_{ij} + 0.01461 \text{REER}$$

(4) According to the regression results, the if $R^2 = 0.99284$, and the adjusted $\text{Adjusted } R^2 = 0.98954$, indicating that the goodness of fit of the model is high. The F statistic is 300.5545, and the corresponding p value is 0, indicating that the model is significant. D. W. value is 2.015987, it can be seen from the table that the upper critical value of D.W. is 2.01599, then D.W. value is in the range of 1.838-2.162, indicating that there is no sequence auto correlation in the model. France's trade openness has passed the t-test at the significance level of 10%, and the rest of the variables have passed the t-test at the significance level of 5%, so each variable has significance.

First, the coefficient signs of China's and France's GDP are all positive, passing the test at the significance level of 5%. It shows that China's export of mechanical and electrical products to France depends on the economic scale of the two countries, that is, the larger the economic scale of the two countries is, the larger the export volume is, and there is a long-term stable equilibrium relationship between them. Given the situations that other conditions remain unchanged, for every 1% increase in China's and France's GDP, the export volume will increase by 1.0836% and 0.9053% respectively. It can be seen that the export volume created by China's GDP growth is greater than the import demand generated by France's GDP growth for the export volume of mechanical and electrical products.

Second, trade openness has a positive effect on export volume, and its coefficient has passed the significance test. China's trade openness was only 16.9% in 1998, and increased to 54.5% in 2011. Although it declined, it still maintained a high level. At the same time, France's trade openness has also increased, from 27% in 1998 to 39.5% in 2017. Generally speaking, the trend of trade openness between the two countries is basically consistent with the export volume, and the promotion effect of China's trade openness is greater than that of France. In the future, China's mechanical and electrical industry needs to make full use of various preferential policies and international resources under the Belt and Road Initiative, so as to continuously push ahead with a new round of high-level opening to the outside world and expand exports.

Third, from the results of empirical test, GDP of China's mechanical and electrical products is positively correlated with the export volume, which is consistent with the expectation. Its t-statistic is 5.510968, P-value is 0.0068, which passes the test at the significance level of 1%. Given the situations that other conditions remain unchanged, For every

1% increase in China's GDP of mechanical and electrical products, the export volume will increase by 2.6804%. Because of the advantage of large output and price, China has created favorable conditions for the export trade of mechanical and electrical products, thus promoting the increase of export volume. By comparing the data, we can also find that the GDP of China's mechanical and electrical products is the most important factor affecting the export volume of mechanical and electrical products.

Fourth, from the results of empirical test, the coefficient of bilateral distance is negative. The bilateral distance reflects the transport cost between trading countries. According to the new trade theory, geographical location is an important factor affecting the trade between the two countries. For the two countries with a long distance, the transportation cost of products is too high, and there are many uncertain factors in the long-distance transportation, which will hinder the export trade. The coefficient of bilateral distance shows that for every 1% increase in transportation cost represented by bilateral distance, the export volume will decrease by 0.3875%, that is to say, the distance between France and China will increase the transportation cost between the two sides of trade, compress the profit space, and restrict the export trade of China's mechanical and electrical products to France.

Fifth, From the results of empirical test, under the condition that other conditions remain unchanged, the RMB real effective exchange rate index has a relatively small positive impact on the export volume of mechanical and electrical products. For every 1% increase of RMB real effective exchange rate index, that is, 1% depreciation of RMB, the export volume will increase by 0.0146%. Exchange rate is an important adjustment lever of international trade. Although the exchange rate of RMB has little impact on the export of mechanical and electrical products from China and France, the mechanical and electrical industry in China should also improve the risk awareness of exchange rate fluctuations.

4. EXPORT TRADE POTENTIAL ANALYSIS

For the calculation of export trade potential, this paper brings the data of explanatory variables into the extended trade gravity model, so as to obtain the predicted value of export volume under the theoretical state, and then divide the actual export volume by the predicted export volume, and the ratio obtained is the export trade potential value. If the ratio is greater than or equal to 1.20, it is a "potential reshape", indicating that the existing trade potential has been exhausted; if the ratio is between 0.80 and 1.20, it is a "potential development type", indicating that the potential of both sides of trade has not been fully exploited, and there is still room for further expansion of bilateral trade relations. If the ratio is less than or equal to 0.80, it is a "huge potential", indicating that there is a huge trade potential, and the possible factors that hinder the growth of export trade need to be excluded.

According to this, this paper calculates the export trade potential value of China's mechanical and electrical products to France in 1998-2017, as shown in Table 5.

Table 5 Export trade potential value of China's mechanical and electrical products to France in 1998-2017

Year	Export potential	Year	Export potential
1998	0.961343	2008	1.229330
1999	1.033353	2009	1.282156
2000	1.037308	2010	1.262565
2001	1.017934	2011	1.098224
2002	0.870049	2012	0.944374
2003	1.072659	2013	0.921970
2004	1.029486	2014	1.087451
2005	0.956858	2015	1.070576
2006	0.973070	2016	0.964181
2007	1.137407	2017	0.988661

According to the calculation results in the above table, export trade potential value of China's mechanical and electrical products to France can be divided into three stages.

(1).Potential development type (1998-2007) .The type indicates that the export potential of China's mechanical and electrical products to France has not been fully exploited, and there is still room for further expansion.

(2).Potential reshape type(2008-2010) .The type indicates that there is excessive trade. On the basis of existing positive factors, it is necessary to cultivate a new growth mode of export trade of China's mechanical and electrical products to France.

(3).Potential development type(since 2011). The export trade of China's mechanical and electrical products to France has returned to the potential development type.

In recent years, France has greatly improved the understanding and depth of the Belt and Road initiative, it has brought new opportunities to explore the multidimensional and three-dimensional cooperation between China and France, and is also conducive to enhancing the core competitiveness of China's mechanical and electrical products in the French market. At the same time, specialized cross-border e-commerce services in various regions of China have become a new engine leading the growth of export trade in mechanical and electrical products. Furthermore, China has opened a number of China EU trains, which facilitates the export of mechanical and electrical products between China and France, greatly reduces transportation costs, reduces the impact of severe weather and uncertain factors on transportation, and expands the export trade potential of mechanical and electrical products from China to France, In general, the export trade relationship of mechanical and electrical products between China and France belongs to the potential development type, and the trade potential needs to be further explored.

5.CONCLUSIONS AND SUGGESTION

This paper analyzes the trade volume and export volume of mechanical and electrical products between China and France from 1998 to 2017. According to the basic principle of trade gravitation model, the paper empirically tests the significance of each influencing factor and measures the potential of export trade. The results shows:

First, since the 21st century, the bilateral trade volume of mechanical and electrical products between China and France has been expanding in general. The empirical results of the extended trade gravity model show that the GDP of China's mechanical and electrical products is the most significant factor affecting the export trade of China's mechanical and electrical products to France, which has a significant positive effect on it. It shows that the optimization and upgrading of industrial structure and the upgrading of production and manufacturing capacity provide favorable conditions for the export of mechanical and electrical products. The economic scale and trade openness of China and France also play a positive role in promoting export trade, while the transport cost represented by bilateral distance will hinder the development of export trade. The real effective exchange rate index of RMB has little influence on the export volume of mechanical and electrical products, but it is also necessary to improve the risk awareness. In addition, there is no long-term stable equilibrium relationship between the population of China and France and the export volume of China's mechanical and electrical products to France, and the per ca pita GDP gap is also.

Second, the calculation results of export trade potential show that the overall trade relationship between China and France in mechanical and electrical products belongs to the potential development type. Although the potential reshape type has appeared in the development process, China's export trade of mechanical and electrical products to France still has a large development space, and the trade potential needs to be further explored.

Therefore, based on the above research results, in order to tap the potential of China's export trade of mechanical and electrical products to France, specific suggestions include:

The government should increase its support. Firstly, we will make greater efforts to promote the reform of

"deregulation services", focus on the concerns of market players and weaknesses, and continue to promote the construction of a market-oriented, legal and international business environment, in particular, based on the smooth development of general export business of cross-border e-commerce in the machinery and electronic industry, the customs should implement data exchange and mutual recognition of supervision, provide specialized customs clearance services based on the whole link of the supply chain, and realize the full coverage of all cross-border e-commerce customs supervision modes so as to promote the development of the machinery and electronic industry. Secondly, the government should increase the investment in scientific research and personnel training in the machinery and electronic industry, improve the level of intellectual property protection, encourage enterprises to strengthen their independent research and development capabilities, and focus on improving the production capacity of mechanical and electrical products with high technology content and high added value. Thirdly, the government should also increase investment in infrastructure along the China Europe train, build an efficient, flexible and low-cost global distribution system, and speed up China Europe train to reduce logistics costs.

Enterprises should pay attention to their own construction Firstly, According to the characteristics of French market and consumer demand preference, Chinese enterprises can develop marketable products, and realize differentiation in terms of product grade, trademark, style and color, or in terms of sales links, packaging and after-sales service, so as to improve the market share of mechanical and electrical products in France. Secondly, enterprises should actively promote independent brands. China's machinery and electronic enterprises should fully understand the manufacturing standards, technical standards, safety and environmental protection requirements of French mechanical and electrical products, adhere to innovation driven, and create independent brands with high technical level, so as to further improve the international competitiveness of China's mechanical and electrical products. Thirdly, focus on cross-border e-commerce of mechanical and electrical products. Cross-border e-commerce is a new channel for enterprises to expand exports. Cross border e-commerce should be committed to providing intelligent and efficient service system, so as to make China Manufacture go further with fast and efficient customs clearance logistics service.

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